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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the photocatalyst filter used for an air cleaner, a sewage treatment unit, a water purifier, etc.
[0002]
[Description of the Prior Art] In recent years, the attempt which uses a photocatalyst for environmental clarification of air cleaning, sanitary-sewage clarification, etc. is active. This disassembles and removes the inside of air, an underwater malodorous substance, harmful matter, etc. according to oxidation of the electron and electron hole which were produced by irradiating the light which has the energy beyond an energy gap in semi-conductors, such as titanium oxide (TiO2), and a reduction operation.
[0003] Since a reaction produces a photocatalysis only on a photocatalyst front face, in the air cleaning and sanitary-sewage clarification using a photocatalyst, the processing matter needs to be efficiently supplied to the front face of a photocatalyst. Then, adsorbents, such as activated carbon, are made to support a photocatalyst and the attempt used for the malodorous substance in air or sanitary-sewage clarification is performed. However, since a reaction arises only in the part equivalent to which light has been, in the thing which made the adsorbent support a photocatalyst, a photocatalysis can do the part equivalent to which light is not, and has the problem that the engine performance of a photocatalyst cannot fully be demonstrated.
[0004] The approach of using the deordorization material which added and fabricated at least one sort of components chosen from from among an ultraviolet-rays sensitizer, translucent ceramics, and translucency plastics to the adsorbent which consists of porous matter which made titanium oxide support with JP,9-75434,A as the deordorization approach using the high photocatalyst of the resolvability ability of a malodorous substance is shown. By ultraviolet-rays sensitization material, translucent ceramics, or translucency plastics, this raises the exposure effectiveness to the titanium oxide of excitation light, and raises deodorant ability.
[0005]
[Problem(s) to be Solved by the Invention] Although powdered or light is able to fabricate to tabular etc. and to penetrate [the particle which mixed an ultraviolet rays sensitizer, translucent ceramics, and translucency plastics with the adsorbent which supported titanium oxide although the technique of the above-mentioned presentation was excellent, or] a certain amount of depth from a deordorization material front face with a binder or adhesives, since each component distributes and exists, it has left the problem of deordorization material referred to as being unable to irradiate light to the interior enough.
[0006] Although what specifically mixed 100g [of activated carbon from coconut shell which supported titanium oxide as an example], 2g [of translucent alumina powder which is 1g of para nitroaniline and translucent ceramics which are ultraviolet-rays sensitization material], and polyethylene powder binder 15g, and was fabricated to tabular is raised The translucency ingredient which leads light to the interior is distributing with powder, since the volume closed to the whole is also small, light cannot be enough supplied to the interior and light catalytic ability of a deordorization entire timber cannot be

demonstrated enough.
[0007]
[Means for Solving the Problem] This invention can supply efficiently the excitation light which irradiated the adsorption material which made a front face thru/or the interior support a photocatalyst, and the excitation light of a photocatalyst from the filter outside by forming a photocatalyst filter in one combining the optical waveguide in which a light guide is possible to the photocatalyst inside a filter, and the photocatalyst filter excellent in disassembly of the processing matter and the clearance engine performance is realized. In addition, it cannot be overemphasized that it is used together with other components and structural materials, such as housing, adhesives, etc. of a filter, in the activity of this photocatalyst filter in many cases.
[0008]
[Function] The photocatalyst filter of this invention is characterized by coming to combine [the optical waveguide in which a light guide is possible] with one the adsorption material which made a front face thru/or the interior support a photocatalyst, and the excitation light of a photocatalyst. The exposure effectiveness of the light to the photocatalyst in a filter is high, and since the light irradiated from the filter outside is drawn to the interior of a filter by optical waveguide with one configuration member of a filter, the capacity of the photocatalyst of the whole filter can be demonstrated enough and it excels in this invention at the decomposition processing engine performance of the processing matter.
[0009] Moreover, in order that the adsorption material currently used as a support base material of a photocatalyst may carry out uptake of the inside of air, or the underwater processing matter efficiently and may raise the contact probability on the front face of a photocatalyst of the processing matter, it excels in the processing engine performance. Even if it is the matter which is easy to generate an intermediate product that it is hard to carry out full decomposition with a photocatalyst, in order to raise the probability for adsorption material to re-adsorb an intermediate product and to contact a photocatalyst front face, it is effective in being easy to carry out full decomposition. Since it is thoroughly decomposed by the photocatalyst, the processing matter made to stick to adsorption material does not have the performance-degradation by adsorption saturation.
[0010] Although anythings are usable if it has adsorbent to the processing matter as adsorption material used as a support base material of a photocatalyst by this invention, from the reasons of the ease of being the thing with a big specific surface area, that the adsorption engine performance is excellent, and acquisition etc., it is desirable to use activated carbon, silica gel, an activated alumina, a zeolite, etc., and it may use these combining plurality independent or if needed. It is important to select the optimal adsorption material with the processing matter, for example, it is good to use activated carbon for clearance of the malodorous substance in air, and clearance of the trihalomethane in tap water, residual chlorine, and a mold odor.
[0011] Although, as for activated carbon, anything can use a grain, powder, fibrous, etc., fibrous activated carbon is the most desirable from forming in the shape of a sheet and being easy to produce a filter configuration so that it may excel in the adsorption engine performance since specific surface area is large, and it may mention later. What is necessary is just to use granular or the thing which was excellent in the adsorption engine performance to the matter to process for it, being able to use all for the raw material of powdered activated carbon, and choosing it as it, although there are a cellulosic fiber, phenol system fiber, pitch system fiber, etc. in the raw material of fibrous activated carbon, such as coconut husks, coal, corks, and charcoal. For example, it is desirable to use the thing of a coconut husks raw material for trihalomethane clearance in tap water.
[0012] The above mentioned adsorption material, such as granular active carbon, powdered activated carbon, silica gel, an activated alumina, and a zeolite, can be easily formed in the shape of a sheet using a binder etc. Moreover, improvement in the function of fibrous activated carbon can also be aimed at by combining the adsorption material of the shape of these grains and powder with fibrous activated carbon. It seems that for example, the clearance engine performance of underwater trihalomethane is put in fibrous activated carbon on Mukai combining the granular active carbon of a coconut husks raw material.

[0013] As a photocatalyst used for this invention, for example TiO2, SrTiO3, and CdS, CdSe, GaP, ZrO2 and KTaO3, and KTa0.77Nb 0.23O3, If it is the matter which has well-known photocatalyst ability, such as Nb 2O5, ZnO, Fe 2O3, WO3, SnO2 and In 2O3, MoO3, Cu2O, and CuFeO2, it can be used in any form of the combination of the matter independent [anythings] or multiple. Especially TiO2 has strong oxidizing power, and especially since it is cheap and harmless, it is desirable. It is more desirable to use an anatase mold with more high catalytic activity, although two kinds of crystal structures, an anatase mold and a rutile mold, exist and both can use TiO2. Or you may use combining both.

[0014] TiO2 front face may be made to support the oxide of metals, such as Pt, Pd, Au, Ag, Ru, Rh, Fe, Co, nickel, Cu, and Zn, or these metals combining independent or plurality in order to raise light catalytic ability. Especially since light catalytic ability is high, the thing which made especially TiO2 front face support a particle with a particle size [of noble metals, such as Pt, Pd and Au,] of 1-100nm is desirable so that it may be well-known. As an approach of making TiO2 front face supporting these metals or metallic oxides, well-known techniques, such as an impregnation method, optical depositing method, chemical deposition method, simultaneous settling, and kneading method, a shaking method, a metal-powder addition method, a vacuum deposition method, and a spatter, can be used. When using TiO2 which supported these metals or metallic oxides, adsorption material may be made to support TiO2 particle which made these matter support, it may be used, and after making adsorption material support TiO2, these ingredients may be made to support and may be used.

[0015] The photocatalyst needs to be supported so that pore of adsorption material may not be buried as much as possible a front face or inside adsorption material. As the support approach of a photocatalyst, they are a sol gel process, a thermal decomposition method, the metal fog method, and CVD. Well-known techniques, such as law, vacuum evaporation technique, a spatter, the ion plating method, and a metal oxidation style, can be used. Moreover, the particle of a photocatalyst may be made to support through the binder of difficulty resolvability to a photocatalyst. What is necessary is just to use well-known things, such as organic system binders, such as inorganic system binders, such as a silica and an alumina, a fluorine system polymer, and a silicon system polymer, as a binder in this case. Since what has a smaller particle size has higher photocatalyst activity, photocatalyst particle powder is desirable, and its thing with the mean particle diameter which is 1-500nm is desirable. TiO2 particle which supported the particle of a metal which was described above, or a metallic oxide on the front face may be used. When a photocatalyst is TiO2, the photocatalyst coating material containing the inorganic binder component marketed may be used.

[0016] Anythings are usable if the light guide of the light which can excite a photocatalyst can be carried out as optical waveguide used by this invention. What is necessary is to choose as a configuration according to the adsorption material which combines the shape of the shape of the shape of FAIBA, and a sheet, tabular, and a cylinder etc., to apply to a necessary filter configuration and just to make it easy. The structure where what consists only of a light guide section, for example like glass fiber confines light in a light guide section, for example like an optical fiber as structure is sufficient. As an ingredient of a light guide section, what has as high the permeability of the excitation light of a photocatalyst as possible is desirable, and when using TiO2 for a photocatalyst, it is desirable to use quartz glass, borosilicate glass, an alumina, a polycarbonate, etc. Specifically as optical waveguide, the glass processed the shape of tabular and a sheet and in the shape of a cylinder, translucency resin, translucent ceramics, etc. can use glass fiber or a quartz fiber, an optical fiber, etc.

[0017] It is desirable for light to leak gradually as the light which carried out incidence spreads inside a filter the optical waveguide used by this invention. It is not necessary to carry out a special device in the optical waveguide which consists only of a light guide section. What is necessary is just to perform that a lens etc. adjusts so that incidence of the light may be carried out by the slightly bigger incident angle than the maximum light-receiving angle which bends an optical fiber and is installed in a filter and on which a part of clad is deleted and a core is exposed etc., when using an optical fiber.

[0018] When using an optical fiber, especially the thing for which the single mode fiber for signal transmissions used by optical communication, such as 1.3-micrometer band, 1.55-micrometer band, and

0.85-micrometer band, is used is desirable. Since such a fiber has the very big cross section of the cross-section ****** clad of a core, the light of the large quantity of light can be made to spread by using a clad for propagation of light. In order for light to spread with leakage moderately furthermore, it is not necessary to control the angle of incidence of light or to bend an optical fiber. Moreover, since the construction material of a clad is a quartz with the high permeability from the light to ultraviolet radiation, even when ultraviolet radiation uses a required photocatalyst for excitation light like TiO2, it is possible to make ultraviolet radiation spread efficiently. Furthermore, it is manufactured for optical communication at the large quantity, and there is also an advantage of being very cheap.

[0019] SONGURUMODOFAIBA can use anythings, if a clad is quartz glass. a fluorine although pure quartz glass with the good transparency property from ultraviolet radiation to the light is the most desirable as a charge of a clad plate -- ** -- what doped the impurity can also be used. Core materials can use anythings and are SiO2+GeO2. Although glass, quartz glass, etc. are easy to come to hand, the impurity may be doped into these ingredients. As a diameter of a clad, a 50-500-micrometer thing is desirable. Since there is little quantity of light which can be spread and a thin thing has it also in reinforcement more than this, it is not suitable, and any more, since it bending-comes to be hard of a thing in case a thick thing makes a filter, it is not suitable. [weak] The quantity of light in which **** is possible, reinforcement, a bending easy, and the ease of acquisition to 100-150 micrometers thing is still more desirable. As a core diameter, 1-25 micrometers is desirable. A thin thing is difficult to produce more than this, and any more, since the quantity of light which the cross section of a clad becomes small and can be spread becomes small, a thick thing is not desirable. The ease of production, the magnitude of the clad cross section, and the ease of acquisition to 5-15 micrometers thing is still more desirable.

[0020] Although there are a single mode fiber for 1.3-micrometer bands, a pure quartz core fiber for 1.55-micrometer bands (cut-off shift fiber), a distributed shift fiber for 1.55-micrometer bands, a single mode fiber for 0.85 micrometer, etc., for example and all can be used as such a single mode fiber, since small 1.3-micrometer band single mode FAIBA of a core system of the propagation effectiveness of light is good, a clad is the most desirable at pure quartz glass. Since the coat of urethane acrylate etc. is usually carried out to the front face in order to secure reinforcement, a plastic coated fiber removes and uses such surface coating. As a removal method of surface coating, the approach of melting, for example from acids, such as a sulfuric acid, etc. can be used.

[0021] Next, the structure of the photocatalyst filter of this invention is explained. As a filter configuration, it can be chosen as arbitration according to the configuration of equipments, such as a sheet, tabular, cylindrical, and a honeycomb. Adsorption material is fibrous activated carbon fabricated in the shape of a sheet, and drawing 1 shows the example of the tabular filter which has the structure together put by the fibrous activated carbon 1 and optical waveguide 2 which supported the photocatalyst carrying out a laminating. What was made into the shape of the shape of the shape of a nonwoven fabric (the shape of felt) and a paper and a honeycomb is contained in the fibrous activated carbon of the shape of this sheet. Although drawing shows the example which used the thing of the shape of a fiber, such as glass fiber and an optical fiber, for optical waveguide 2, it can be used choosing it not only from the shape of a fiber but from the thing described previously. In the example of drawing, it is used from the filter top face out of which the end face of fiber-like optical waveguide has come, carrying out incidence of the excitation light.

[0022] Drawing 2 (a) is fibrous activated carbon by which adsorption material was fabricated in the shape of a sheet, and the fibrous activated carbon 1 and optical waveguide 2 of the shape of a sheet which supported the photocatalyst show the example of a cylindrical filter by which arrangement ******** was carried out to concentric circular. Drawing 2 (b) shows the example of the cylindrical filter which wound around the multiplex curled form the fibrous activated carbon 1 and optical waveguide 2 of the shape of a sheet which supported the photocatalyst. Although drawing shows the example which used the fiber-like thing for optical waveguide, it can be used choosing not only out of the shape of a fiber but out of the aforementioned thing. In the example of drawing, it is used from the filter top face out of which the end face of fiber-like optical waveguide has come, carrying out incidence

of the excitation light.
[0023] What drawing 3 (a) bundled the continuous glass fiber-like activated carbon 3 and the fiber-like optical waveguide 4 which are fibrous activated carbon with which spinning of the adsorption material was carried out to the shape of continuous glass fiber, and supported the photocatalyst, and formed the sheet Drawing 3 (b) shows what knit the continuous glass fiber-like activated carbon and the fiber-like optical waveguide 4 which supported the photocatalyst, was crowded, and formed the sheet, and by fabricating two or more sheets of these sheets to tabular in piles, or rolling them, it is fabricated in the shape of a cylinder and it uses it as a filter. Drawing shows an example of how to bundle continuous glass fiber-like fibrous activated carbon and fiber-like optical waveguide or how to knit, and may form a sheet depending on how to bundle others or how to knit. These examples are especially desirable structures from using fibrous activated carbon with the high adsorption engine performance, that especially the exposure effectiveness of excitation light is excellent, and filter production being easy.
[0024] Drawing 4 arranges the cylinder-like optical waveguide 5 to concentric circular, and shows the cylindrical filter in which the adsorption material 6 which carried out photocatalyst support between these optical waveguides 5 was put. With this filter, the hole 7 is made in the side face of cylinder-like waveguide so that the gas and liquid which are processed toward a cylindrical core from a cylinder side face or a cylinder side face can be circulated from the hole of a cylindrical core.
[0025] It is a mere example of the photocatalyst filter of this invention which was explained using drawing above, and if it has the configuration which combined the adsorption material which supported the photocatalyst at least, and optical waveguide as explained so far, it can use the thing of the structure of arbitration. Optical waveguide is prolonged to the filter exterior and you may be the structure which carries out incidence of the excitation light from the place distant from the filter. Moreover, in the aforementioned explanation, although it described that generation of optical waveguide should just have been based on a well-known approach at the adsorption material list which supported the photocatalyst, it cannot be overemphasized that it does not interfere by the new approach which may be produced from now on, either.
[0026] A thing with the wavelength which can excite the photocatalyst supported to adsorption material as a light which carries out incidence from an optical waveguide end face for a photocatalysis can be used, and an artificial source or sunlight, such as filament lamps, such as fluorescent lamps, such as discharge lamps, such as a mercury lamp and a xenon lamp, a fluorescent lamp, the black light, and germicidal lamp glass, and an incandescent lamp, and a laser light source, can be used as the light source.
[0027] The photocatalyst filter of this invention can be used for processing of a gas or a liquid by using it combining the above mentioned light source for photocatalyst excitation. As gas processing, for example, decomposition clearance of the malodorous substance in air, bacteria, etc., Decomposition clearance of harmful matter, such as an organochlorine compound in exhaust gas, and NOx in atmospheric air To oxidation clearance etc., as processing of a liquid It can use for decomposition clearance of decomposition clearance of harmful matter, such as decomposition clearance of harmful matter, such as an organochlorine compound under wastewater, and agricultural chemicals in an underground water, the trihalomethane in tap water, residual chlorine, the mold odor matter, bacteria, etc., clearance of the heavy metal ion in wastewater or tap water, etc. Moreover, it can use for H2 generating by the photolysis of water, or the photolysis of water etc.
[0028]
[Embodiment of the Invention] The following example describes the gestalt of concrete operation of this invention.
[0029]
[Example] Fibrous nonwoven fabric-like activated carbon was used for example 1 adsorption material, and TiO2 was made to support as follows as a photocatalyst. First, tetra-ethoxy silane 100g was melted to ethanol 1000ml, 500ml of solutions which mixed water, a nitric acid, and ethanol by the mole ratio of 1:20:100 was added, and the silica sol was prepared. After having dipped fibrous activated carbon in the thing which added the particle powder (the Ishihara Sangyo make, ST-01) of the anatase mold TiO2 to

this, and it was made to distribute, pulling up and drying, it calcinated at 400 degrees C for 1 hour, and the TiO2 support fibrous activated carbon nonwoven fabric was obtained. Using a quartz fiber with a diameter of 100 micrometers as optical waveguide, the laminating of the TiO2 support fibrous activated carbon nonwoven fabric was carried out to what bundled this and was made into the shape of a sheet by turns, and width of face with the structure of drawing 1 of 35cm, die length of 30cm, and a thickness 5mm tabular filter were produced.

[0030] Initial concentration of 100 ppm diluted with atmospheric air while irradiating ultraviolet radiation using the black light fluorescent lamp of 10W from the upper part of a filter so that this filter might be built into the gaseous-phase-reaction equipment of a closed cycle system and light might carry out incidence from the end face of a quartz fiber The acetaldehyde was circulated through the filter. the place which measured aging of the acetaldehyde concentration after optical exposure initiation by the gas chromatograph -- 2 hours after -- acetaldehyde concentration -- 1 ppm up to -- it decreased. Although the above actuation was repeated 10 times, the clearance capacity of an acetaldehyde did not change.

[0031] What bundled the TiO2 support fibrous activated carbon nonwoven fabric produced like example 2 example 1 and the quartz fiber with a diameter of 100 micrometers, and was made into the shape of a sheet was piled up, and the cylindrical filter with the bore of 3cm which winds this around a curled form and has the structure of drawing 2 (b), an outer diameter [of 5cm], and a die length of 30cm was produced.

[0032] It is the initial concentration of 1 ppm, irradiating ultraviolet radiation using the black light fluorescent lamp of 10W from the upper part of a filter so that this filter may be built into the liquid phase reactor of a closed cycle system and light may carry out incidence from the end face of a quartz fiber. The treated water containing 2-methyl isoborneol was circulated through the filter. Treated water was circulated so that it might escape from the hole of a cylindrical center from a cylinder side face to the exterior through a cylinder. the place which measured aging of 2-methyl isoborneol concentration after optical exposure initiation with the gas chromatograph mass spectrometer -- after 30 minutes -- 2-methyl isoborneol concentration -- 0.01 ppm up to -- it decreased. Although the above actuation was repeated 20 times, the clearance capacity of 2-methyl isoborneol did not change. In addition, it cannot wind around a curled form depending on the need, but can also form in the shape of a cylinder like drawing 2 a.

[0033] Using the fibrous activated carbon by which spinning was carried out to the shape of continuous glass fiber at example 3 adsorption material, TiO2 was supported like the example 1 and TiO2 support continuous glass fiber-like activated carbon was obtained. The core which removed surface coating in the hydrogen-sulfide water solution 10% as optical waveguide used 8 micrometers of diameters of SiO2+GeO2 glass, and the clad used the single mode fiber for 1.3-micrometer bands of 125 micrometers of diameters of quartz glass (the Sumitomo Electric Industries make, lot number:ES-1), and the single mode fiber was used for warp, it used TiO2 support fibrous activated carbon continuous glass fiber for the weft, it wove in in the shape of a grid, and the sheet with the structure shown in drawing 3 (b) was formed. This sheet was rolled so that a single mode fiber might become the longitudinal direction of a filter, and the filter of the shape of a cylinder with the bore of 3cm, an outer diameter [of 5cm], and a die length of 30cm was produced.

[0034] It is the initial concentration of 1 ppm, irradiating ultraviolet radiation using the black light fluorescent lamp of 10W from the upper part of a filter so that this filter may be built into the liquid phase reactor of a closed cycle system and light may carry out incidence from the end face of a quartz fiber. The treated water containing trichloroethane was circulated through the filter. Treated water was circulated so that it might escape from the hole of a cylindrical center from a cylinder side face to the exterior through a cylinder. the place which measured aging of the trichloroethane concentration after optical exposure initiation by the gas chromatograph -- after 30 minutes -- trichloroethane concentration -- 0.02 ppm up to -- it decreased. Although the above actuation was repeated 20 times, the clearance capacity of trichloroethane did not change. In addition, depending on the need, it does not weave in in the shape of a grid, but they can also be used, being able to put the above-mentioned warp and a

horizontal system in order like drawing 3 (a), and bundling them.
[0035] The granular activated carbon from coconut shell of 50 meshes of standard grading was used for example 4 adsorption material, TiO2 was supported like the example 1, and TiO2 support granular active carbon was obtained. The quartz glass of the shape of a cylinder with 2mm [in thickness] and a die length of 30cm with which the hole opened was used for the side face as optical waveguide. Optical waveguide used that in which only a thing with a bore of 5cm has a pars basilaris ossis occipitalis using five sheets whose bores are 3cm, 3.5cm, 4cm, 4.5cm, and 5cm. These have been arranged to concentric circular, it was filled up with TiO2 support granular active carbon between optical waveguides, and the cylindrical filter with the structure of drawing 4 was produced.
[0036] It is the initial concentration of 1 ppm, irradiating ultraviolet radiation using the black light fluorescent lamp of 10W from the upper part of a filter so that this filter may be built into the liquid phase reactor of a closed cycle system and light may carry out incidence from the end face of quartz-glass waveguide. The treated water containing chloroform was circulated through the filter. Treated water was circulated so that it might escape from the hole of a cylindrical center from a cylinder side face to the exterior through a cylinder. the place which measured aging of the chloroform concentration after optical exposure initiation with the gas-chromatograph mass spectroscope -- after 30 minutes -- chloroform concentration -- 0.01 ppm up to -- it decreased. Although the above actuation was repeated 20 times, the clearance capacity of chloroform did not change.
[0037] The silica gel of six meshes of average grain size was used for example 5 adsorption material, and TiO2 was supported with the sol gel process. After having added 150ml of isopropanol solutions of 80wt(s)% titanium tetraisopropoxide to 750ml of pure water, and 5ml of nitric acids first, producing the titania sol by hydrolysis as a procedure of a sol gel process and carrying out the DIP coat of the titania sol to silica gel, it calcinated at 550 degrees C and TiO2 support silica gel was obtained. Using the cylindrical quartz glass same to optical waveguide as an example 4, TiO2 support silica gel was used instead of photocatalyst support granular active carbon, and the same cylindrical filter as an example 4 was produced.
[0038] Initial concentration of 100 ppm diluted with atmospheric air while irradiating ultraviolet radiation using the black light fluorescent lamp of 10W from the upper part of a filter so that this filter might be built into the gaseous-phase-reaction equipment of a closed cycle system and light might carry out incidence from the end face of quartz-glass waveguide Tetrachloroethylene was circulated through the filter. Gas was circulated so that it might escape from the hole of a cylindrical center from a cylinder side face to the exterior through a cylinder. the place which measured aging of the tetrachloroethylene concentration after optical exposure initiation by the gas chromatograph -- 2 hours after -- tetrachloroethylene concentration -- 5 ppm up to -- it decreased. Although the above actuation was repeated 10 times, the clearance capacity of tetrachloroethylene did not change.
[0039] If the photocatalyst filter of this invention is used as mentioned above, the inside of a gaseous phase, an underwater malodorous substance, harmful matter, etc. can be disassembled and removed efficiently. Since light is efficiently irradiated by optical waveguide over the whole filter, a throughput is high, and since the matter by which the adsorption material inside a filter was adsorbed is also disassembled efficiently, even if it repeats a reaction, the clearance engine performance does not deteriorate.
[0040]
[Effect of the Invention] As explained above, according to this invention, the excitation light irradiated from the filter outside can be efficiently supplied to the photocatalyst inside a filter, and the photocatalyst filter excellent in disassembly of the processing matter and the clearance engine performance can be realized.

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CLAIMS

[Claim(s)]
[Claim 1] A filter is a photocatalyst filter characterized by the excitation light which came to combine with one the optical waveguide in which a light guide is possible, and irradiated the adsorption material which made a front face thru/or the interior support a photocatalyst at least, and the excitation light of a photocatalyst from this filter outside being supplied to the photocatalyst inside a filter by optical waveguide.
[****** 2] Adsorption material is a photocatalyst filter according to claim 1 characterized by coming to combine one sort in activated carbon, silica gel, an activated alumina, and a zeolite, or two sorts or more.
[Claim 3] The photocatalyst filter according to claim 1 or 2 characterized by being tabular [by which adsorption material was fabricated in the shape of a sheet, and the laminating of the optical waveguide was carried out to this sheet-like adsorption material].
[Claim 4] The photocatalyst filter according to claim 1 or 2 characterized by the cylindrical thing by which adsorption material was fabricated in the shape of a sheet, and this sheet-like adsorption material and optical waveguide have been arranged concentric circular, and for which it is cylindrical or this sheet-like adsorption material and optical waveguide were wound around the multiplex curled form.
[Claim 5] Spinning of the adsorption material is carried out to the shape of continuous glass fiber, and it is formed in the shape of a sheet whether the both bundle optical waveguide by being formed in the shape of a fiber, and by being knit and crowded, or they are that the shape of this sheet is cylindrical, or the photocatalyst filter according to claim 1 or 2 characterized by a multiplex curled form coming to be fabricated.
[Claim 6] Claim 1 characterized by optical waveguide being a single mode fiber for optical communication, claim 2, claim 3, a photocatalyst filter according to claim 4 or 5.
[Claim 7] Claim 1 characterized by a photocatalyst being titanium oxide, claim 2, claim 3, claim 4, a photocatalyst filter according to claim 5 or 6.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is a perspective view explaining the configuration of the photocatalyst filter of an example 1.
[Drawing 2] (a) and (b) are the perspective views explaining the configuration of the photocatalyst filter of an example 2.
[Drawing 3] (a) and (b) are the top views explaining the configuration of the photocatalyst filter of an example 3.
[Drawing 4] It is a perspective view explaining the configuration of the photocatalyst filter of an example 4.
[Description of Notations]
1 Fibrous Activated Carbon Which Supported Photocatalyst
2 Optical Waveguide
3 Continuous Glass Fiber-like Activated Carbon Which Supported Photocatalyst
4 Fiber-like Optical Waveguide
5 Cylinder-like Optical Waveguide
6 Adsorption Material Which Supported Photocatalyst
7 Hole Established in Side Face of Cylinder-like Optical Waveguide

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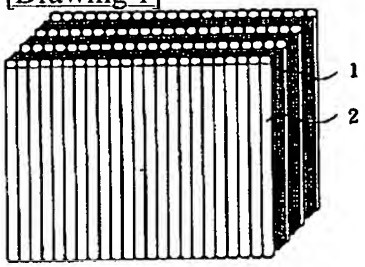
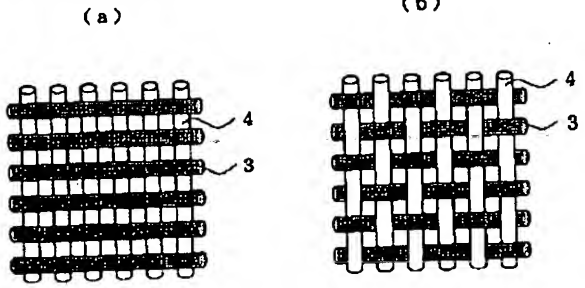
DRAWINGS

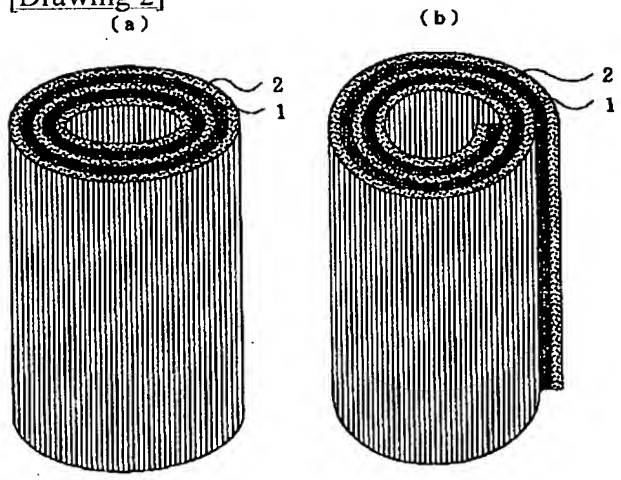
[Drawing 1]



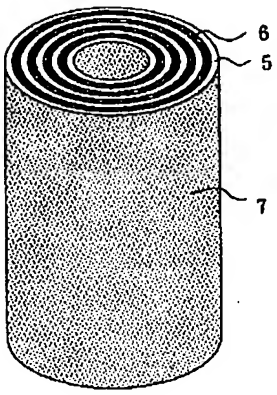
[Drawing 3]



[Drawing 2]



[Drawing 4]



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